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SCHARFF'S HISTORY OF THE EUROPEAN FAUNA.

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IN a recent volume of the *Contemporary Science Series*, Dr. Scharff¹ has given us, under the above title, an elaborate attempt to trace the origin of the present fauna of Europe and to some extent also its flora. He has followed up the various migrations which have taken place in that continent chiefly since Pliocene times, and indicated the routes which in his opinion they must have followed, as well as the obstacles which barred their way in other directions. This leads to a discussion of the conditions of climate and distribution of land and water during the glacial epoch. He has thus brought face to face in one volume some of the most important problems in zoölogy, botany, and geology, and whether we agree in his conclusions or not, we owe him a debt of gratitude for the admirable manner in which he has laid the whole question before us and for the mental stimulus which his presentation of it is sure to infuse into the discussion.

¹ Scharff, R. F. *The History of the European Fauna*. London, Walter Scott, 1899. viii + 364 pp., 8vo, 21 figs. and maps in text.

In the introductory chapter Dr. Scharff, starting out from the present fauna of Great Britain and Ireland, demonstrates its heterogeneous composition, embracing, as it does, animals, the affinities or geological history of which point to their southern, northern, or eastern origin, and shows that in all probability the southern forms must have extended northward from the continent long ages ago, while the others arrived comparatively recently. He then discusses the means of dispersal possessed by the various animals, especially "the occasional means," as Darwin called them, and ventures to think that both Darwin and Wallace have somewhat overestimated its significance, and he reaches the conclusion that five per cent would be a high estimate for the animals which have reached British soil by accidental means. This proportion he regards as insignificant, in fact as utterly negligible.

In the second chapter, which is headed "Preliminary Considerations," Dr. Scharff endeavors to show how to determine approximately the original home of an animal so as to be able to study the component elements of the European fauna. As one of the results he announces that what was formerly believed to have been one great northern invasion now resolves itself into two distinct ones—the Siberian and the Arctic. An examination of the present distribution of mammals, snails, and earthworms shows that the British Islands have been connected with one another and with the continent; Spain with Morocco across the Straits of Gibraltar; Greece with Asia Minor, and so forth. The British fauna forms the key to the solution of the wider problem of that of Europe, five elements being recognizable, of which the Lusitanian is the oldest and the Siberian the most recent. A discussion of the climate of Europe during the glacial period follows, in which Dr. Scharff tries to maintain that so far from being of an Arctic nature the climate was mild, possibly even milder than at present, to which result he is mainly led by a contemplation of the striking and most remarkable mingling of a northern and a southern fauna during the Ice Age. An extensive glaciation, as advocated by modern geologists, is consequently denied and evidence brought forward to demonstrate the marine origin

of the boulder clay as opposed to its character as bottom moraine. Under such climatic conditions portions of the fauna and flora¹ were enabled to continue their existence in localities reached by them in preglacial times.

The British fauna is taken as a convenient starting point and is treated of in the third chapter. Examples are given of the more noteworthy forms belonging to the three foreign elements of which it is composed, *vis.*, the northern, eastern, and southern, as well as a small endemic one, and adhesion given to the almost unanimous opinion of biologists that the bulk of the British fauna and flora (biota?!) is attributable to invasions by land from the continent. As for the relative age of these invasions and the geological periods in which they entered the British Islands, Dr. Scharff feels convinced that the southwestern or Lusitanian fauna, and also the flora, must have arrived before the glacial period and survived the latter. The Alpine and Oriental invasions arrived next. After these came the Arctic, and finally the eastern, or Siberian. The geological age of the latter is most easily traced because of the more complete fossil evidence at hand. As the Siberian invasion arrived in Germany after the deposition of the lower boulder clay, consequently after the first portion of the glacial period had passed, it would seem to follow that the Forest Bed in England, which geologists hold to be preglacial, must be interglacial, corresponding to the Loess formation of central Europe. The chapter concludes with statements of facts showing a continuous coast line to have existed between France and Ireland.

With the fourth chapter Dr. Scharff takes up in detail the discussion of what he calls the "Arctic fauna." The basic

¹ The author, like many other writers on similar subjects, has felt the need of a comprehensive term to include both fauna and flora which will not only designate the total of animal and plant life of a given region or period, but also any treatise upon the animals and plants of any geographical area or geological period. As such a term I would suggest *Biota*, not only because its original significance covers the above definition, but also because of its brevity and obvious relationship to the term "Biology" as embracing Zoölogy and Botany. *Biotic* would then signify "pertaining to or treating of a biota," as. — a biotic publication, a biotic region.

supposition upon which rests the whole theory of the Arctic immigration, in so far as such terrestrial animals are concerned, which require a continuous land connection, consists in the assumption that America and Europe were connected far north between Scandinavia, Spitsbergen, and Greenland until toward the end of the glacial period, while Norway again was continuous with Scotland across the North Sea, and England (and Ireland) with France. The earliest traces of such an immigration he finds in certain so-called American plants and fresh-water sponges which are found on the northern and western coasts of Ireland, in the Hebrides, in Scotland, and in North America. "The geographical distribution of some of the Arctic species is referred to in greater detail," to use Dr. Scharff's own words in his summary of this chapter, "to show how the relative age of their entry into Europe can be determined. Two forms of reindeer, resembling the Barren-Ground and Woodland varieties, have been met with in European deposits, but only the former occurs in Ireland and the south of France, whilst eastward the other becomes more common, and finally is the only one found. It is believed that the Barren-Ground is the older form as far as Europe is concerned, and that it came to us with the Arctic migration, and that the other reindeer reached Europe much later from Siberia, when Ireland had already become detached from England. The range of the Arctic hare is equally instructive. It must have been a native of Europe since early glacial or preglacial times—before the common English hare had made its appearance in central Europe. Along with other Arctic forms it entered northern Europe directly from the Arctic regions by means of the former land connection which joined, as I remarked, Lapland with Spitsbergen, Greenland, and North America." The stoat, or ermine, is another distinctly northern animal which Dr. Scharff regards as having reached Ireland and England at two different times; the one from the Arctic regions as a northern migrant, the other with the Siberian fauna from the east, and its range is made to include Greenland and Spitsbergen. He also thinks that there can be no doubt that the British grouse belongs to the northern migration, and the

ptarmigan and snow bunting are also reckoned as invaders from the north. Several other animals are mentioned as Arctic; thus the various lemmings, though it is not quite clear whether he regards these as belonging to the Arctic immigration, since they are also included in the animals constituting the Siberian contingent. The character of the flora is also alluded to as strengthening the theory of an Arctic (*i.e.*, North-America-Greenland-Spitsbergen-Scandinavia-Scotland) route, though a postglacial connection between Europe and Greenland is not insisted on, as the present flora of that country may have survived the glacial period in the Arctic regions. Professor Forbes's opinion, that the occurrence of certain shore Mollusca, both on the coast of Finmark and Greenland, shows that these two countries were not long ago joined, is alluded to, and the view that the continental boulder clay is a marine deposit is again brought forward as fitting so much better with the known facts of distribution.

The Siberian invasion forms the subject of Chapter V, in which a number of British animals, living and extinct, are traced to a Siberian origin, chiefly mammals, and some birds. Among many of the lower vertebrates and invertebrates there are but few species which in Dr. Scharff's opinion have reached England from Siberia. They may have had their original homes in the Alps, in eastern Europe, or in central and southern Asia, and have joined in their westward course the later, more quickly traveling mammals. No less than twenty-six species of the Siberian mammals, according to Scharff, penetrated as far west as the British Islands, and nine of these still inhabit Great Britain. Some of the remaining seventeen species probably lived only for a very short time in England, and the rest gradually became extinct one by one. Our author enumerates them as follows¹: *Canis lagopus*, *Gulo luscus*, **Mustela erminea*, **M. putorius*, **M. vulgaris*, **Sorex vulgaris*, *Lagomys pusillus*, **Castor fiber*, *Spermophilus eversmanni*, *S. erythrogenoides*, *Cricetus songarus*, *Myodes lemmus*, *Cuniculus torquatus*, **Mus minutus*, **Arvicola agrestis*, **A. amphibius*, *A.*

¹ Those marked with an asterisk still inhabit Great Britain, or did so within historic times.

arvalis, * *A. glareolus*, *A. gregalis*, *A. ratticeps*, *Equus caballus*, *Saiga tartarica*, *Ovibos moschatus*, *Alces latifrons*, *A. machlis*, *Rangifer tarandus*. It will be noticed that this list contains species which have also been quoted as Arctic immigrants, in which case, however, Dr. Scharff regards them as having arrived at different times both from the north and from the east. It will also be observed that several species which from their present distribution are regarded as Arctic,—as, for instance, *Canis lagopus* and *Ovibos moschatus*, the Arctic fox and the musk ox,—are given as Siberian immigrants, the latter obviously because it has not been found in Norway, and consequently cannot have come by way of the latter country from Greenland. In discussing the route by which these animals arrived and their origin, Dr. Scharff returns to his *præterea censeo*, that a mild climate prevailed then in central Europe; and in reply to Nehring's "steppe theory" he states that we have really no idea under what precise climatic conditions the Siberian mammals lived in their original home, and offers evidence from other synchronous animals, such as the mollusks, to show that they afford no proof of a steppe character of the country at the time when they were alive. Additional support is derived from the evidence of a connection between the Caspian and the White Sea which would have prevented the Siberian fauna from spreading westward in Pliocene and early glacial times. But on disappearance of the marine connection a way would have been opened into central Europe. The marine character of the boulder clay is again reverted to, and the age of the English Forest Bed determined as interglacial, contemporaneous with the German interglacial beds also containing the bones of these Siberian migrants.

While the so-called Siberian invaders came from the east, they entered Europe by a more northern route than a large number of animals which also came from Asia, but by way of Asia Minor. They compose what Dr. Scharff calls the Oriental migration, which is treated of in detail in Chapter VI, and of which he himself has given the following summary :

"They originated in central, southern, and western Asia. It is not easy to discriminate in all cases between the Oriental

migration and the Siberian. To a certain extent, even an entry of northern Asiatic species has taken place by the southern route, and *vice versa*. On the other hand, southern species might have come to Europe by the southern route — that is to say, to the south of the Caspian — and also by the northern, which lay to the north of that great inland sea. The red deer [*Cervus elaphus*] is a good example. It arrived on our continent by both routes. However, there is a racial difference in the members of the two migrations. The small race now found in Corsica, Sardinia, northwest Africa, and western Europe is probably the older of the two, while the larger one — resembling the American wapiti deer — arrived very much later from Siberia.¹

“The mammoth, wild boar, badger, the dippers, and pheasants are all Oriental species which have come to us from the southeast; but there are also reptiles and amphibians, and a host of invertebrates. Not all the animals, for instance, which have reached us in England from the southeast are of Asiatic origin. There is an active center of distribution in southeastern Europe itself, from which species radiate out in all directions. This fact is well illustrated by the genus *Clausilia*. Species from this center, and also from the Alps, joined the Oriental stream in their northward course.

“In reviewing a number of instances of Oriental species in Europe one is struck by the peculiarity of their having apparently followed two distinct routes. All entered from Asia Minor, which is proved to have been connected with Greece until recent geological times. From here some seem to have proceeded straight west, others northward. Further study reveals the fact that the first route was followed by a much older set of migrants at a time when the Mediterranean area was greatly different from what it is at the present day. Greece was then joined to southern Italy, Sicily, and Tunis. The latter was also connected with Sardinia and Corsica, and the Straits of Gibraltar did not exist. Under such geographical

¹ On page 250 it is stated that it appears that it (*i.e.*, the larger race of deer) also reached England. *Cervus elaphus* is not enumerated by Dr. Scharff, however, as one of the Siberian migrants on page 202. — L. S.

conditions a direct migration on land from southern Greece to Spain was not only possible, but was actually undertaken by a very large number of Oriental species."

Chapter VII treats of the Lusitanian fauna in detail. As already mentioned, Dr. Scharff regards this element as the oldest in the British Islands, its antiquity being indicated by the discontinuous distribution of so many of its species. As Lusitanian, he regards species having their origin in the southwestern portions of Europe, "or on the mysterious lands which lay beyond it." Not all the species which have entered Great Britain from that direction, however, are true Lusitanian, inasmuch as many of the Oriental invaders are supposed to have traveled as far as Spain by way of the Mediterranean route, and then, proceeding northward, to have reached France, Ireland, and England. Only one mammal is treated of as undoubted Lusitanian, *viz.*, *Oryctolagus cuniculus*, the rabbit; but several birds are mentioned as having a southwestern origin, prominent among which are the Dartford warbler (*Melizophilus undulatus*), the pied wagtail (*Motacilla lugubris*), and the genus *Fringilla*. Among the lower vertebrates there are more species of this kind. Thus the ancestors of the amphisbænian lizard (*Blanus cinereus*) are supposed to have entered Europe by way of the sunken "Atlantis"; other probable Lusitanians are the Discoglossoid toads and the salamandine genus *Chioglossa*. Various butterflies, beetles, and spiders may be similarly traced to a southwestern origin, but especially a large number of land mollusks, notable among which is the spotted slug (*Geomalacus maculosus*), which is known only from Portugal and few localities in southwestern Ireland.

The Alpine fauna forms the subject of the last chapter, the eighth. The history of this part of the fauna begins with the rise of the Alpine island in the Miocene sea. This island, being first connected with the mainland to the east, naturally received its first inhabitants from that direction; and Dr. Scharff regards them as having formed part of the older Oriental invasion, many species of which, by long isolation and the elevation of the Alpine country, became modified into very distinct species, thus forming as it were a new fauna.

At least this is the way I understand Dr. Scharff when he speaks of indigenous Alpine species. Following these came the newer Oriental invasion. During Pliocene times dry land gradually supplanted the sea to the north of the Alps, and their Biota (fauna and flora) poured into the plain. At that period Arctic species from the north (*via* Scandinavia, Great Britain, and France) and Lusitanian forms from the west found their way to the Alps. The true Siberian types came much later, *viz.*, in the Middle Pleistocene, making their appearance at the foot of the Alps, though it is doubtful whether many of them ever reached the mountains. Thus he accounts for the presence of the so-called Scandinavian species in the Alps, and *vice versa*, in two ways — first, an early northern invasion directly from Scandinavia to the Alps *via* England, and, second, by both Scandinavia and the Alps receiving a share of the Siberian colonists, parts of which went north, while others went south. Dr. Scharff is thus led to disagree with Forbes's theory, once quite generally accepted, that this similarity between the mountain faunas of northern and southern Europe was due to a gradual forcing south of the northern species and north of the southern ones by the expanding glaciers on both sides, by their mingling in the intermediate territory and subsequent retreat to their old homes when the glaciers receded, the northern forms mixed with some Alpine species and *vice versa*. Nehring's Tundra theory is also dissented from in so far as it regards the Siberian animals as forming the nucleus of the faunas of these two areas. Dr. Scharff ends the summary of this chapter, and thus the book, with the following remarks: "One of the most important conclusions obtained by this study of the flora in conjunction with the fauna, is that I have emphasised in most of the preceding chapters — *viz.*, that the glacial period in Europe was not a time of extreme cold, and that its destructive effect on the animals and plants was by no means such as is currently believed."

This last sentence is in a measure a clue to Dr. Scharff's whole book, which must be read in the light of it. It must be admitted that he has made out a good case, from the

standpoint of the biologists, against the view that would ascribe to the glacial period so severe a cold and so enormously and universally developed an ice sheet, or ice cap, that all life became extinct and every inch of ground hidden by a thick covering of perpetual ice. I doubt, however, that this is currently believed by the biologists of to-day. I do not think I am much out of the way when I say that most of us regard the conditions and climate of the Ice Age in Europe to have been on the whole much like the conditions and climate of Greenland and the island world north of Hudson Bay at the present time. It would therefore be possible for us to subscribe to Dr. Scharff's conclusion as above worded were it not that in the book itself he goes much farther, requiring, as he does, a climate in central Europe at least as mild as that of the present day or even milder. The present reviewer at least cannot admit that the known facts relative to the distribution of animals and plants during Pliocene and Pleistocene times require such a hypothesis for their satisfactory explanation.

It may be true "that with a comparatively slight change of the atmospheric conditions in the British Islands, we might have glaciers back again on all our highest ranges in England, Scotland, and Ireland" (p. 69), and it may also be true that Falsan, whom Dr. Scharff quotes with evident approval, is right when he says "that the mean annual temperature of France during the glacial period was approximately from 6-9° C., perhaps more. This," Dr. Scharff continues, "is the actual mean annual temperature of the southwest of Sweden and Norway, or the north of Scotland." Of course this statement is correct enough, but the whole question assumes a somewhat different aspect when we consider that the temperature indicated by Falsan means a lowering of the annual temperature of about 5°. This would mean for Berlin a July isotherm like that of Archangelsk; for Berlin and Vienna, a January isotherm like that of the south end of Greenland and an annual isotherm like that for the country between Sitka and the Aliaska peninsula. Under the same conditions Edinburgh would have a summer like the extreme

northern Iceland and Bering Straits and a January temperature like that of Reikiavik.

On page 183 Dr. Scharff makes the following statement: "Everybody knows that northern and Arctic species can live perfectly well in a temperate climate, but that it is almost impossible to acclimatize southern animals in an Arctic or even temperate one. We have in this circumstance almost a proof, therefore, that the climate cannot have been very cold. Though a cold sea bathed the shores of eastern England, and even eventually invaded a portion of northern England, the warm ocean on the west must have effectually prevented any great lowering of temperature." Of course a good deal depends on what we understand by "great." At the period of which Dr. Scharff treats he admits that a cold Arctic current came down along the eastern base of Scandinavia, washing the east coast of England on the west and the northern shore of central Europe on the south. Now, England has even to-day a warm ocean on the west coast; does he imagine that if a cold current — like the Labrador coast current — were to strike the east coast of England the temperature of the British Islands would not be "greatly" lowered? On the two sides of the Atlantic the warm and the cold currents make a difference in the annual temperature of the countries of the same latitude of about 10° C. Such a lowering of the annual temperature in Europe east of Ireland would bring the climate of South Greenland, Labrador, and the Hudson Bay countries to middle England, Holland, central Europe, down to Vienna, the northern edge of the Black Sea, and the northern forth of the Caspian Sea; it would also render Lapland and northern Finland equal to Baffin Land, while the climate of Spitsbergen would be as severe as that of Grinnell Land or both sides of Smith Sound. Under similar conditions France and northern Italy would have the same yearly temperature as Newfoundland, Winnipeg, and the Aliaska peninsula. The conditions which must have prevailed in Germany when land and water were distributed approximately as indicated by Dr. Scharff on his map on page 170 remind one strikingly of a combination of Hudson Bay and Baffin Bay, a combination certainly not

liable to ameliorate the climate which in the adjoining countries cannot have been much different from that of Baffin Land. This conception is of course widely different from an absolutely unbroken ice sheet with a temperature destructive of all higher life, but it is also greatly different from the idea of Dr. Scharff. Moreover, it is not inconsistent with a possibility of even a considerable number of southern forms having survived the glacial period in various sheltered nooks and corners. The humming bird occurs even as far as Sitka, almost in sight of the gigantic glaciers, and forests are known to grow above a substratum of ice. The Lusitanian species in Ireland may well have survived the glacial period, even including the spotted slug (*Geomalacus maculosus*). The fact that it occurs in Cork and Kerry Counties of Ireland to-day does not prove that it lived there throughout the glacial period, and that consequently the glacial climate was mild or milder than now, for on page 156 Dr. Scharff has a chart showing Ireland to have extended probably a couple of hundred miles farther south, this extension forming a large peninsula which must have been washed on both sides by comparatively warm currents. It is quite possible that the more tender species of the Lusitanian fauna enjoyed here a congenial climate during the greatest glaciation, retreating to their present stations in Ireland as the sea rose and the glaciers receded. It is therefore scarcely necessary to postulate a temperate climate for Europe during glacial times. Not only did considerable changes of the climate take place during that period over large areas, but there must of necessity also have been a great variation inside this vast area according to local conditions, while in the adjacent countries not directly subjected to the glaciation these local variations must have been vastly greater. We see even to-day isolated spots having a southern temperature within the limits of countries with a northern climate, and on the other hand similar northern oases in regions bounded by isotherms indicating a southern climate.

One of the principal reasons which has led Dr. Scharff to assume such a mild climate in Europe at that time is the mixture of southern and northern forms in several deposits.

The occurrence of the bones of the hyena, the reindeer, and the hippopotamus in the same caverns at Kirkdale, of the lion and northern voles near Paris, of "the mammoth, the woolly rhinoceros, horse, ox, reindeer, Arctic fox, lemming, and Pica" in the same deposit at Thiede, seems to him ample proof of a southern climate, as he is of the opinion that a northern species can much easier exist in a southern climate than a southern species in a northern one. Dr. Scharff continues (p. 74): "If, in a central European deposit, occurs a mixture of northern and southern forms of animals, the presence of the latter is more remarkable than that of the former. Logically, we should look upon the occurrence of southern species in the north, therefore, as supporting the view that a mild climate had induced them to travel northward." In order to show, however, that this "extraordinary mixture of northern and southern types of animals" is no indication of a warm climate, I will call Dr. Scharff's attention to the fact that we have a striking example even at the present day. It may seem a paradox to many, yet it is a fact that there is a district in eastern Asia where the tiger¹ (which we are used to regard as much a tropical animal as the lion and the rhinoceros) hunts the wild reindeer. That part of Manchuria where this "extraordinary mixture" occurs has an annual temperature of between 0 and -2° C.; in other words, like south Greenland, south Labrador, and central Kamchatka. Surely, this woolly tiger might easily have lived at Thiede during the glacial period at the time of the deposition of the bones of the mammoth, the woolly rhinoceros, etc., and it is just as sure that the presence of its tropical bones in the German deposit would not prove that central Europe then had a subtropical climate.

It seems to me that Dr. Scharff's whole train of reasoning in this matter rests on a misconception. I have above quoted the following axiom of his: "Everybody knows that northern and Arctic species can live perfectly well in a temperate climate, but that it is almost impossible to acclimatize southern animals in an Arctic or even temperate one." On page 74 he

¹ *Felis tigris mongolica* (Lesson).

says: "Breeders of animals and those acquainted with zoölogical gardens know perfectly well that it is much easier to keep a northern species in a southern climate than a southern species in a northern one." Similarly he returns time and again to the curious delicacy of Arctic plants in botanical gardens as a proof that their presence in central Europe during glacial times is no evidence of an Arctic climate. He even adduces the fact that *Dryas octopetala*, one of the most typically Arctic plants, grows wild in profusion on the coast of Galway, in Ireland, at sea level, as strengthening "the view, not only that the Alpine flora is of preglacial origin, but that the climate of Europe during the glacial period was mild."

That the Arctic and Alpine floras survived the glacial period there is but little reason now to doubt, but that conclusion is not inconsistent with an Arctic climate in which all these plants even now flourish. But from this admission to the assumption that the climate was mild is a long cry and the two conclusions are not logically connected. Much less is the inference justified, which Dr. Scharff evidently draws, that the animals and plants which we now find characteristic of the Arctic regions originated during the glacial period during the mild climatic conditions and afterwards were driven off into the Arctic or the Alps by more vigorous invaders from Siberia accommodating themselves to the much severer climate. With regard to the plants, here are Dr. Scharff's own words (p. 239): "This fact [*i.e.*, the difficulty of wintering these plants in the Botanical Gardens] suggests that the Alpine and Arctic plants really did not originate in countries with cold temperatures. They probably made their first appearance long before the glacial period — perhaps in early Tertiary times — chiefly in the Arctic regions, which at that time had a mild climate. They have since become adapted to live in cold countries where they flourish, provided they receive sufficient moisture in the summer, and are protected from severe frost in the winter by a covering of snow." Apart from the fact that this theory is diametrically opposed to his own idea of the difficulty of southern species to accommodate themselves to a northern climate, as expressed above, both views, and in fact the whole

argument, rest upon the fundamentally wrong idea that whole assemblages of species—or single species for that matter—can accommodate themselves to so different conditions without changing their specific identity. Surely the examples which Dr. Scharff mentions, while referring to the difficulty of keeping southern animals and plants alive in northern climates, and, *vice versa*, the greater ease with which northern animals survive in temperate countries, refer to individuals only, though he speaks of species. It is a pretty well established fact by this time that the distribution of an animal or plant (species) is limited within a certain life zone beyond which it cannot proceed with impunity; and that this life zone is bounded by certain isotherms of the propagating season, boundaries which may differ with each species but which are fairly inflexible within the species. This *law*, which Dr. Merriam has so successfully defined and elaborated, renders it certain beyond a doubt that the presence in central Europe of a breeding and propagating assemblage of animals and plants practically identical with that of the Arctic and sub-Arctic regions of to-day indicates a corresponding climate during the propagating season; in other words, the life zone of these Arctic and sub-Arctic species was at some period during the glacial epoch located in central Europe, plants, animals, temperature, and all.

Another reason for Dr. Scharff's adoption of the theory of a mild glacial climate is the alleged marine origin of the boulder clay. Various deposits of marine invertebrate fossils in stratified beds are cited as proof that the boulder clay is not of the nature of a ground moraine. While this question probably is one in which the geologists are more directly concerned, I may say that, in my humble opinion, the most reasonable explanation is that the boulder clay is of a dual origin,—that part of it is deposited on land by the ice sheet, while other portions were formed at the bottom of the sea, dropped by floating ice and bergs. There can be but little doubt that the enormous weight of the Scandinavian ice cap depressed the land to the south of it, so as to bring it under the level of the sea. There was probably always a more or less extensive sea skirting it to the south and east, preceding the glaciers as

they extended southward, following them in their retreat to the north, receiving and distributing the ice floes and icebergs with their deposits in various places according to the varying conditions, such as changes in currents and winds and the oscillations of the rise and fall of the earth's crust. A sea like that, shut out from connection with the Atlantic Ocean to the west, only connecting with the Arctic Sea to the north, and fed by the melting ice and snow of the surrounding countries, would present features something between the Baltic and Hudson Bay. Its waters would naturally be brackish, and consequently deficient in marine life, except in a few favorable localities. The supposition of such a sea would meet all the requirements the biologists can put to it; it would explain the varied conditions of the boulder clay and the presence as well as the scarcity of the distinctly marine deposits. It would also meet their demand for an effective barrier north of the Caspian Sea to the invasion of Siberian forms during the earlier part of the glacial period, as a combination of glacier and sea is as effective for this purpose as either of these agents alone. On the other hand, it certainly cannot be taken as an indication of a mild climate, possibly milder than our present one.

While I have thus been unable to accept one of Dr. Scharff's more general and fundamental propositions, *viz.*, the one which relates to the glacial climate, there is another of his more special conclusions from which I must also dissent, *viz.*, the northern origin of the invasion, which he styles the Arctic migration.

As already explained above, Dr. Scharff accounts for the presence of certain Arctic animals in Ireland, Scotland, and other parts of western Europe, including the Alps and the Pyrenean peninsula, by a supposed immigration from America, *via* a continuous land connection between Greenland, Spitsbergen, Norway, Great Britain and Ireland, and France, this immigration being only subsequent in age to the Lusitanian fauna, and distinctly older than the Siberian immigration, which came to Europe much later from the east, though also consisting, to a great extent, of northern types closely allied to those composing the Arctic invasion.

There is at once a fatal objection to this theory, *vis.*, that there can have been no such land connection during Pliocene or Pleistocene times between Greenland and Spitsbergen. It was formerly generally believed that the Arctic Sea was a fairly uniformly shallow basin, but as one of the most important results of Nansen's *Fram* expedition we know now that the sea north of Spitsbergen and Francis Joseph Land is very deep, certainly more than 1600 fathoms, while to the west of Spitsbergen, between it and Greenland, we have soundings as deep as 2650 fathoms. A wide channel between these countries, certainly not less than 1500 fathoms in depth, connects the North Atlantic deep with the polar basin. It can be said with the utmost certainty that an elevation sufficient to bridge this and thus connect Greenland with Spitsbergen has not existed during the geological periods mentioned.¹ It is highly probable that the extreme elevation in that part of the world at that time did not exceed the present 300-meter line. At all events, there must have been a gap between land and land of at least 150 miles, a distance quite sufficient to bar all migration of the mammalia which Dr. Scharff includes in his Arctic fauna.

But apart from this insuperable barrier, there is a good reason why Spitsbergen cannot have been in the route of these animals, *vis.*, that with one exception they do not occur in Spitsbergen, nor were they ever known to occur there. The Arctic hare is certainly absent, and the records of a lemming and the ermine are highly dubious. Even if it should be true that a lemming occurs there, it is pretty safe to say that it is

¹ It will scarcely do to regard the dead shells of shoal water forms, such as *Yoldia arctica*, which the Danish "Ingolf" expedition in 1896 dredged between Iceland and Jan Mayen Island in depths between 500 and 1300 fathoms, as proof of a corresponding depression since glacial times. It is incredible that these dead shells which are scattered all over the surface of the bottom of the North Atlantic Ocean should have been lying there loose all these thousands or ten thousands of years without being covered up or destroyed. I certainly agree with those who hold that these shells have been dropped there by shore ice floated out to sea. It will be noted, moreover, that even the supposition of an extreme rise of 1300 fathoms does not affect our argument as to the continuity of Greenland and Spitsbergen, since they would still be separated by a deep channel at least 150 miles wide.

Cuniculus torquatus, the presence of which would rather work against Dr. Scharff's theory, since it does not occur in Scandinavia at all. The Spitsbergen reindeer, on the other hand, is so different from the one of Norway that it does not seem probable that one is the lineal descendant of the other. Add to this that the sea between Norway and Spitsbergen is more than 300 meters deep, and an exchange of terrestrial mammals between these two countries becomes highly improbable.

Before proceeding any farther I wish to state that while disagreeing with Dr. Scharff in his supposition of a continuous connection between Greenland and Spitsbergen and between the latter and Norway, over which his Arctic invaders might have traveled, I am in full accord with him in regard to the land bridge between Norway and Great Britain across the North Sea, and also in his conclusion that most of the immigrants which he designates as Arctic belong to an invasion different from and considerably older than the great Siberian immigration. That I also accept the continuity of Great Britain with Ireland and France, the breaking down of this connection between the two former prior to that between England and France, goes without saying; but I do not exactly agree with him in his views as to all the higher vertebrates which he attributes to this invasion.

To any one who is familiar with the present and past distribution of the Norwegian lemming (*Myodes lemmus*¹) it must be somewhat surprising to find it included by Dr. Scharff among his Siberian colonists, rather than among the Arctic invaders. The reasons are obvious, *viz.*, first, because this rodent does not occur in America and Greenland, whence the Arctic invasion is supposed to have come; second, because it has not as yet been found fossil in Ireland, where, according to the theory, it should have occurred if it arrived in Great Britain before the land connection with Ireland broke down, an event later than the arrival of the Arctic invaders according to Dr. Scharff's chronology. This negative evidence, however, would have been counterbalanced, I imagine, by the fact that remains

¹ I adhere in this review to the nomenclature used by Dr. Scharff without regard to my own preference in the matter, in order to avoid confusion.

belonging to the Norwegian lemming type have lately been discovered in Portugal, since it is one of Dr. Scharff's criteria of a Siberian migrant that it does not occur south of the Alps or Pyrenees, were it not for the impossibility of ascribing an American origin to this species. As I have shown that none of the other Arctics can have come that way, and as the lemming otherwise agrees so well with them in their present and past distribution, I think there can be no difficulty about referring them to the same category.

Nor can I endorse Dr. Scharff's treatment of the various ptarmigans (*Lagopus*). On page 336 he sums up his conclusions to the effect that "*L. albus* and *L. mutus* appear in our continent chiefly¹ as Arctic migrants." His reason for so regarding the former is given on page 334, where it is stated that "no doubt the British grouse is a descendant of the Scandinavian willow grouse. The latter is known also to inhabit Greenland and Arctic North America, and is even found beyond Bering Straits in northern Siberia." In the first place, as the British grouse (*Lagopus scoticus*), with its brown wing-feathers, is almost certainly nearer the original common ancestor of the willow grouse,² it would be the Scandinavian willow grouse (*L. albus*) which must be regarded as the descendant, if there really be a direct line of descent between the two, and not *vice versa*. In the second place, it is easy to show that the geographical distribution of *L. albus* is not that of an Arctic species in Dr. Scharff's sense. It will be noted that he gives Greenland among the localities where this species is found. But it is one of the peculiarities of the distribution of this species that it does not occur in any part of Greenland. It is also absent in Spitsbergen and Iceland, and a route of immigration from America by any one of these countries is consequently out of

¹ On page 334 he regards the latter both as Arctic and Siberian; see also page 142.

² The probability that the dark wing color of *L. scoticus* might be the result of reversion is very remote. In a species so variable in its coloring we should in such a case expect a very frequent cropping out of so universal a character immediately and comparatively recently preceding the last change. It must be remembered that the white wing-feathers are characteristic of all the other species and forms of the genus, and that they are not subject to seasonal color changes like the rest of the plumage.

the question. Altogether this species is not found in most of the truly Arctic regions, as it is absent, not only in the above-mentioned islands, but also in Novaya Zemlya, Francis Joseph Land, Taimyr Land north of 72° , New Siberian Islands, Wrangel Land, and the Aleutian Islands. Its northern limit consequently agrees almost exactly with that of the wolverine (*Gulo*) which Dr. Scharff counts among the Siberian invaders.

With regard to the Tundra ptarmigans (*Lagopus rupestris* and *mutus*) our knowledge is unfortunately not quite so complete, owing to the difficulty of distinguishing correctly between these two forms; but, as Palmén has already indicated, it is highly probable that the latter does not occur east of the White Sea, that in fact it is confined (with its local races) to the Scandinavian mountains with their Lapland spurs, Scotland, the Alps and the Pyrenees, while *L. rupestris* (with its various forms and subspecies) extends over the entire Siberian and North American Tundra and Barren Ground, as well as Spitsbergen, Greenland, and Iceland. The former, therefore, is nearly uniform in its distribution with *Myodes lemmus*, while the latter corresponds fairly well to that of *M. obensis* (and its local forms). The significant fact in this connection, in so far as the ptarmigans are concerned, is that both the Spitsbergen, the Greenland, and the Iceland forms belong to the Siberian and American *L. rupestris*, while the Scandinavian and Scotch (also probably subfossil English and Irish) ptarmigans, with those of Switzerland and the Pyrenees, form the *L. mutus* group. These, therefore, cannot have come from America *via* Greenland and Spitsbergen (or Iceland).

But while thus this group of animals, which Dr. Scharff has called Arctic immigrants, by both physical and distributional reasons is barred from the route America-Greenland-Spitsbergen-Norway-Scotland-western Europe, it may be pertinently asked, By what road did they reach western Europe, Scotland, and Norway?

Let us first determine where they did *not* come from. Having eliminated Greenland and Spitsbergen, there are to the northward only two countries which need be further investigated, *viz.*, Norway and Iceland.

The latter might have been dismissed in a few words, were it not that Dr. Scharff, in his history of the European fauna, practically has no reference to the fauna of Iceland, the origin of which certainly is as European as that of Great Britain itself. Almost the only allusion to the famous island is a brief paragraph to the effect that if a land connection existed between Greenland and Scotland in that direction "it must have been in very early Tertiary times." Granting that there was no such continuous land bridge any more at the beginning of Pleistocene times or even during the Pliocene, by which the larger herbivorous animals could have migrated from Greenland to Iceland and Scotland, it is evident that the conditions must have been much different from what they are indicated to be on Dr. Scharff's diagrammatic maps on pages 156 and 170, in which the present sea level is maintained at Iceland and eastern Greenland, while the continental platform is raised about 200 fathoms at the western coasts of Ireland, Scotland, Norway, and Spitsbergen. Under such a distribution of land and water Iceland, though still an island, must have been much larger, while the Farøe Islands, forming a large island of nearly the present size of Ireland, were separated from Scotland by a comparatively narrow channel, and numerous islets on the high ridge between the Farøe Islands and Iceland constituted a series of stepping-stones to the latter. Such a state of affairs would of course effectually block the way of the mammals, without being a bar to many other animals, as the birds, for instance. To any one familiar with the land birds of Iceland it is perfectly plain that it would require at least that much of an interrupted land connection to make it possible for them to have developed a highly frequented migration route across that now nearly trackless ocean. I will mention only one example, *viz.*, the large-winged race of the common wheatear (*Saxicola arnanthe leucorhoa*). This race, characterized by a length of wing of over 100 mm., is known to breed in Greenland and adjacent portions of northeastern Arctic America and to migrate in winter over Iceland, the Farøe Islands, the Shetlands, Great Britain, and probably thence along the western edge of France and the Pyrenean peninsula to Africa, returning in spring the

same way to its Arctic home. For this bird to have found a way to America there must at the time have existed a route fairly well outlined by islands more extensive and more numerous than now, and the very fact that this route of the extension of its distribution (for it belongs to an exclusively Old-World genus) became an annual migration-route points plainly to the existence of such an interrupted land bridge some time in the glacial period. However, the total absence of the reindeer, the hare, the lemming, the ermine, and the musk ox in Iceland is incontrovertible proof that the Arctic mammalian invasion into western Europe did not come by way of Iceland.

There remains then only Norway as the last possible home of these animals if they arrived from the north at all. The question, however, at once presents itself: If they arrived in Scotland from Norway by way of the North Sea bridge, by what route did they then come into Norway? It is of course out of the question to suppose that they originated in that country situated at the extreme northwest periphery of the Old World, as they are all closely allied to species of arctogæan derivation. On the other hand, there seems to have been no other land connection at that period between Scandinavia and the rest of the Eurasian continent than that with Scotland. It is pretty generally agreed that the sea then covered the lowlands of northern Russia to the east, thus effectually cutting off any communication between Siberia and Lapland. Apart from the considerations which have influenced that conclusion it would be very difficult to explain the absence from the Scandinavian peninsula of a number of both Arctic and Siberian animals had there been a land connection in that region during the earlier and middle stages of the glacial period. The total absence of *Cuniculus torquatus* and the musk ox is particularly significant.

It would then appear that we are compelled to conclude that the mammals and birds in question did not come to Great Britain and Ireland from the north at all. They certainly did not come from the west, and it is equally certain that they formed no part of the Lusitanian fauna. There seems then to be no other way by which they could have reached England

and Ireland except over the land connection with France. But how did they get into France? Where did they originally come from? Various reasons preclude any hypothesis of these animals being part of the Oriental invasions, and the offshoot of the later, the Alpine fauna. Their relationships are decidedly Siberian, not central or south Asiatic, and the lemmings, as well as the willow ptarmigan, are quite foreign to the Alps. I have already expressed my agreement with Dr. Scharff that they do not form part of the great later Siberian invasion; they were present in northern Europe long before that event, as shown by their history in the British Islands.

It goes without saying that the relationships of these Arctic animals are decidedly northern and, as already remarked, equally closely Siberian, and I have no doubt that northern and western Siberia was their home, before they invaded western Europe. I am therefore compelled to recognize two distinct Siberian invasions (or rather three, since a third one is in progress to-day) widely separated in time.

The first Siberian invasion (Scharff's Arctic) took place early, probably before the first great glaciation had reached its maximum. Neither ice nor water had yet shut off the passage north of the Caspian Sea and along the northern edge of the central European mountain ranges. Thus the Tundra reindeer, the variable hare, the ermine, the Norwegian lemming, the ptarmigan, the willow grouse, and others penetrated westward to France (and the Pyrenean peninsula) and over the then continuous England, Ireland, and Scotland to western Norway without leaving any traces in the continental boulder clay which was deposited only after they had passed. The maximum of the first glaciation then barred the further ingress of any more Siberians; the boulder clay was deposited next, and on the retreat of the glaciers or rise of the land, — or rather both, — the second Siberian invasion, among which were several of the same species as the first, took place over the boulder clay. It is my impression that the musk ox and the banded lemming (*Cuniculus torquatus*) formed part of the first invasion, but for some reason or other failed to reach sufficiently far west and north early enough to pass into Ireland or Norway. It may

also be questioned whether the willow grouse reached Norway at that time, as such an assumption would involve the dilemma of either regarding *Lagopus scoticus* as a reversion since glacial times or else of supposing the Scandinavian and the present Siberian *Lagopus albus* to have originated independently and yet specifically identically from the brown-winged ancestor, none of which propositions I am at present prepared to accept. To me it appears most probable that *Lagopus scoticus* belongs to the first Siberian invasion reaching Great Britain and Ireland only, but not penetrating to Norway, and that *Lagopus albus*, the white-winged willow grouse, belongs to the second invasion entering Scandinavia from the south. I do not know that anybody has been able to distinguish the bones of these two forms, and it appears most likely to me that the fossil remains which Milne-Edwards records from France and Italy as *L. albus* really belong to *L. scoticus*. The occurrence of the latter south of the Alps is a fairly good indication that it belonged to the first invasion. However that may be, the others must have reached Norway, where they still survive, by the above route, and while the willow grouse, the Norwegian lemming, and the Tundra reindeer died out in central Europe, the remaining species, except the musk ox and Cuniculus, saved themselves in the southern mountain ranges and in congenial parts of Ireland.

It is quite probable that several other species, members of the older Oriental invasion, joined the preglacial Siberian immigration in France. As one of these I regard the red deer of Scotland and Norway, which doubtless forms a small-antlered race, or subspecies, of *Cervus elaphus*. Its distribution in Norway is highly interesting and suggestive, occurring, as it does, only along the western coast from Stavanger up to about Namsos (65° north latitude). It is here confined to the outer coast line, chiefly to the larger islands, while it is entirely absent in the interior or eastern Norway. The deer there, consequently, is restricted to that part of the country lying to the west and north of the backbone of the great ice cap which extended from southwest to northeast across the Scandinavian peninsula during the glacial period. To the south of this ice

divide red deer occur at present only in southern Sweden, but these belong to the great central European race, and it is highly interesting to note that a subfossil antler of this large form also has been found in southeastern Norway, in Ringerike,¹ consequently on the south side of the ice divide. This large-antlered deer, therefore, probably entered the Scandinavian peninsula from the south at a much later period, while the smaller Scotch form came early across the North Sea bridge and settled on the islands off the west coast of Norway. It will be seen that this hypothesis agrees pretty well with Dr. Scharff's views, expressed on page 250, as follows: "There were probably two distinct migrations of the red deer into Europe, an older one coming from Asia Minor into Greece, which stocked Sardinia, Corsica, Malta, and North Africa in the first place, when these were still connected with one another. This same migration likewise affected western continental Europe, the Irish red deer being probably the descendant of this very ancient stock. The latter entered the island when it was still part of the continent. The later migration of a larger form came from Siberia and spread mainly over eastern and central Europe, but it appears that it also reached England, although there is no evidence of any of these Siberian deer having ever inhabited Ireland." It will be seen that the case is exactly parallel to that of the deer in Norway. Dr. Scharff also calls attention in this connection to the double invasion of the reindeer, but under my supposition that both of the latter came from the east the parallelism is still more striking.

One isolated fact appears at first sight to be antagonistic to my theory of western Norway having been invaded from Scotland and not *vice versa*, as Dr. Scharff thinks, *viz.*, the occurrence of a reindeer in Spitsbergen. I have above expressed the opinion that there was not a direct land connection between Spitsbergen and northern Norway at the time when Dr. Scharff's Arctic migration must be supposed to have taken place. Whence then did the Spitsbergen reindeer come from if not from Norway? Unfortunately, the interrelationship of

¹ Collett. *Nyt Mag. Naturv.*, Bd. xxxvi (1898), p. 360.

the various forms, or subspecies, of reindeer is as yet too imperfectly known¹ to permit us to answer this question with any degree of certainty, but I wish to call attention to the fact that the Spitsbergen reindeer (*Rangifer spitzbergensis*) is too different from the typical wild Scandinavian stock to make it probable that the former is a direct descendant from the latter or *vice versa*. On the other hand, the rise of the land in that region 300 meters would still see Norway separated by the sea from Spitsbergen, at the same time leaving the latter connected by dry land with Novaya Zemlya, and there is at present nothing known which would prevent us from assuming that the reindeer originally came to Spitsbergen from Novaya Zemlya and Taimyr Land in Siberia.²

In defense and elaboration of his theory of an Arctic migration by way of Arctic America, Greenland, Spitsbergen, Lapland, Dr. Scharff also discusses the travels of the insects and plants and comes to the conclusion that they argue for a land connection along this route. I think it altogether likely that such a dispersal took place, and would even call attention to the fact that the plants along the north coast of Spitsbergen show a greater percentage of Arctic-American plants than those of southern Spitsbergen as corroborative of this theory, but I must insist that an unbroken land connection is not at all necessary for the dispersal of plants and insects along that route, if currents of air and sea were favorable. Dr. Scharff in his preliminary chapter would reduce this kind

¹ If these exceedingly important questions are ever to be solved, it is necessary that they be investigated at once by some competent authority. Not only are the wild reindeer becoming scarce everywhere from excessive hunting, but they are also being mixed up in the various localities to such an extent that extreme care will have to be exercised in using whatever material can now be brought together. Thus in Norway large herds of the Lapland tame reindeer have been located on the southwestern fiells, where they mingle with the wild ones of a possibly different stock; in Spitsbergen also tame Lapland reindeer have become feral, as some of the draft animals which Professor Nordenskiöld brought with him from Finmarken ran away; tame Asiatic reindeer have been brought by the thousands across Bering Straits to America, and a herd of Lapland reindeer have also been introduced into Alaska to add to the confusion.

² Dr. Scharff in his discussion of the migrations, etc., of the reindeer (pp. 149-158) seems to argue out of the premises that the Barren-Ground reindeer do not occur in Siberia, but this is a mistake.

of dispersal to a minimum because the many happy coincidences necessary for a species to establish itself on a distant shore must be exceedingly rare. But granting this, we must not forget that while the recorded actual observations of direct accidental transplantation and subsequent establishment are few and far between, our entire experience covers scarcely a couple of centuries, while the periods of which we here treat are reckoned in thousands, possibly tens of thousands of years. And how many lucky chances may not have presented themselves in ten thousand years! Moreover, the distances with which we have to do in the present case only look formidable in the Mercator projection, while in reality they probably did not exceed 150 miles. I believe it to be a distinct mistake to suppose that all classes and kinds of animals and plants have followed the same lines of distribution in time and space. As a matter of fact, it may be even said that there are scarcely two species which have exactly the same history. Each one must be worked out separately, and too sweeping generalizations are dangerous at the present state of our knowledge.

It is one of the distinct merits of a book like Dr. Scharff's that it makes plain these defects in our knowledge. It is a kind of stock-taking by which we find out just how our business stands. It must then be admitted with regret that the status is not as satisfactory as one might have reason to expect. There is yet a great uncertainty as to the exact and detailed distribution of many of the larger and more important animals in the Arctic regions and in Europe. The grosser facts are known of course in a general way, but they are not sufficient for the purpose. The finer details are still unknown, or if known in some isolated cases are unavailing because they are as yet only isolated. American mammalogists, for instance, have studied some of the species here treated of in so far as they relate to American forms, but this knowledge is at present a dead one, because the corresponding Asiatic and European forms are still in chaos, or *vice versa*. Dr. Scharff's book shows that there is still much necessary work to be done by the "splitter" of species and subspecies, but it also shows that this work must be done with some purpose in view and

not in the ordinary perfunctory manner for the mere naming and labeling of museum specimens. The time has come when the interrelationship and the sequence in time and space of the various subspecies must be studied. A perusal of *The History of the European Fauna* should make clear to the average describer and namer of animals that his work is only the means to an end. It brings before him the very problems for the solution of which his work is necessary, and the more conscious he becomes of the uses to which it is to be put, the better and more reliable it is apt to be performed.

I do not know whether Dr. Scharff is to be commended or not for having withstood the temptation to correlate the immigration of man into Europe with that of the other post-Pliocene mammals. The wanderings of the plants are alluded to in order to strengthen the views expressed relating to the origin of the fauna. The travels of primitive man must to a great extent have followed much the same lines as the other mammals, the same natural barriers being nearly as effective in his case as in theirs. It might be said that it would require volumes to exhaust this subject alone, but that is almost equally true of all the various groups of animals. Then again it might be objected that our knowledge of the wanderings of prehistoric man in Europe is very limited and uncertain. I think, however, it can be safely asserted that it is not any more so than our knowledge of the migrations of the animals and plants in the same period, and I venture to suggest that there is a remarkable similarity between the migrations we have discussed above and those of the various European subspecies of man.

The first point to be observed is that the dolichocephalic brunet Mediterranean, or Atlanto-Mediterranean, race in its distribution both in time and space clearly corresponds to Dr. Scharff's "Lusitanian fauna." The agreement is not only a general one, but in some details almost startling, as seen if one compares, for instance, Scharff's map on page 7 with any map showing the distribution of the brunet type in the British Islands.

The next point is the almost self-evident absence of an "Arctic immigration" by way of Greenland-Spitsbergen-Norway-British Islands. On the other hand, the "Alpine fauna," the offshoot of the Oriental immigration, is plainly represented by the brachycephalic Alpine race of unmistakable Asiatic relationship. These "round-barrow men" in their westward push reached the British Islands, though they have left but few traces, except their bones, behind them there. Ireland may have been separated at the time of their invasion, since they do not seem to have reached that island, but they penetrated to the extreme of Scotland, the Shetlands, the Faröe Islands, and, as I believe, by that route — the North Sea bridge, either yet intact or only broken to the extent of furnishing stepping-stones — to western Norway, where to the present day this Alpine population holds the extreme west coast to almost the identical extent as the red deer, a most suggestive distribution when we compare it with what has been said above about the probable route of immigration of that animal in Norway. It is true that there are traces of an Alpine population in other parts of southern Norway, especially in Smaale-nene, and that a migration along the Danish peninsula has been suggested. It is even likely that part of the broad-headed dark Norwegians have come by the latter route as well, but this view is not necessarily antagonistic to the above theory.

Finally the long-headed blond Nordic, or Teutonic, race, the last to arrive, corresponds substantially to the "Siberian invasion."¹ Whether any part of this can be paralleled with the preglacial, or first, Siberian stream which I have indicated above, I am not now prepared to say, but the question should be carefully looked into.

¹ This view does not antagonize the theory of the African origin of the dolichocephalic race. On the contrary, I hold that the portion of the latter which ultimately developed into the blond branch originally expanded from eastern Africa to western and central Asia. Here, in the high altitudes, I take it, the bleaching began, which after the race joined the second Siberian invasion, became more and more pronounced as it progressed westward and northward, until it reached its extreme development of blondness at the extreme northwestern point of its range, *viz.*, in Sweden.

It will be seen that Dr. Scharff's book has tempted me even beyond its own limits. This suggestiveness must serve not only as an excuse for this transgression, but also for the length of this review. It is one of the greatest merits of the book.

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